



Pilot/Vehicle Operator Training for Operational Evaluation of Runway Status Lights (RWSL) at DFW and SAN

January 2005

RWSL Pilot/Vehicle Operator Training Outline

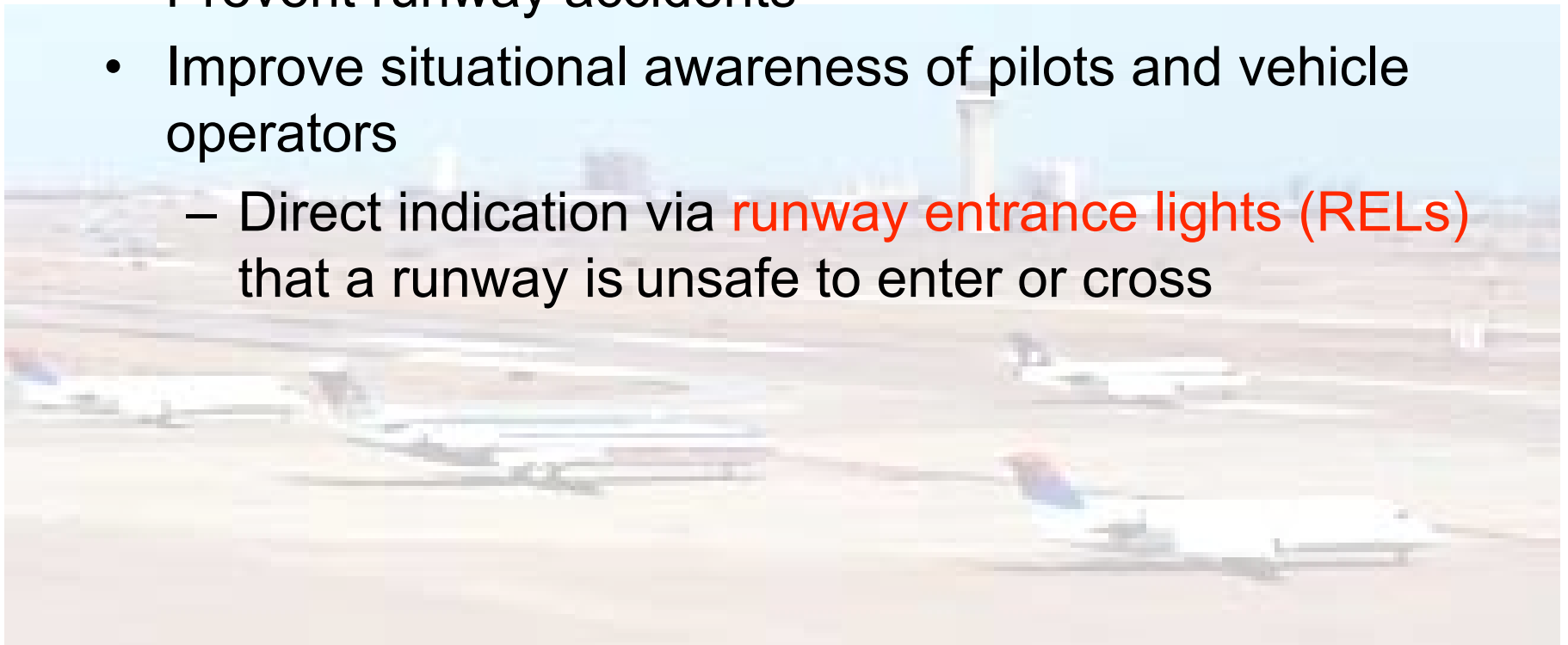
- Runway incursion problem
- Runway Status Lights (RWSL) solution
 - RWSL operational concept
 - RWSL operational evaluation at DFW
 - RWSL operational evaluation at SAN
- Summary

Runway Incursion Problem

- Definition
 - “A runway incursion is any occurrence on an airport runway involving an aircraft, vehicle, person, or object on the ground that creates a collision hazard or results in a loss of separation with an aircraft taking off, intending to take off, landing, or intending to land.” [Source: FAA Runway Safety Office]
- Causes
 - Operational errors, pilot deviations, and vehicle/pedestrians deviations
 - **Pilot deviations** are the largest cause of runway incursions

RWSL Solution

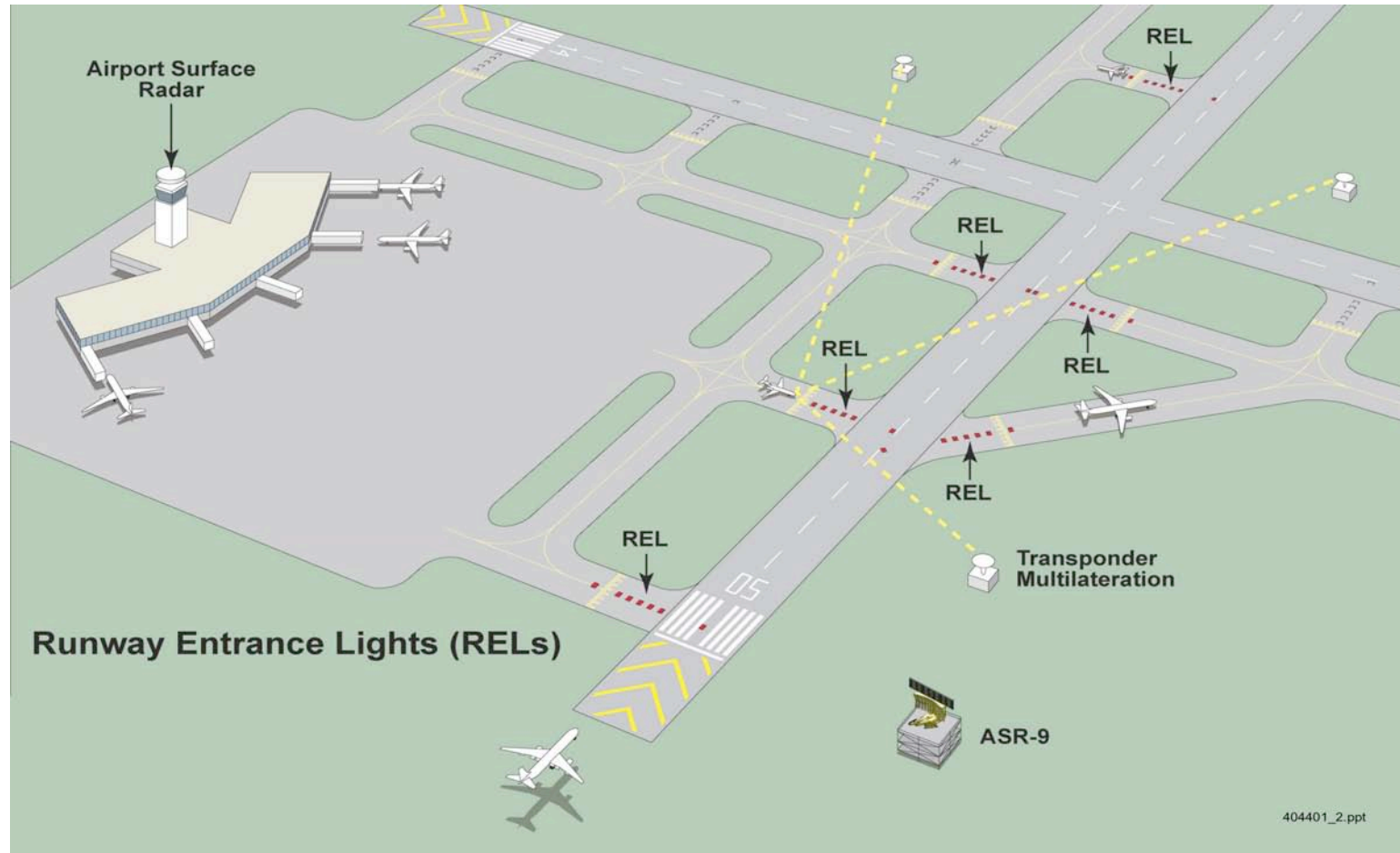
- Reduce frequency and severity of runway incursions
- Prevent runway accidents
- Improve situational awareness of pilots and vehicle operators
 - Direct indication via **runway entrance lights (RELs)** that a runway is unsafe to enter or cross



Objective

- To familiarize pilots/vehicle operators with RWSL
- To train pilots/vehicle operators in appropriate procedures with RELs
- To mitigate human error:
 - “The three most common errors by pilots that lead to runway incursions are failure to hold short, turning on the wrong taxiway, or crossing a runway without clearance.” AOPA

RWSL Operational Concept

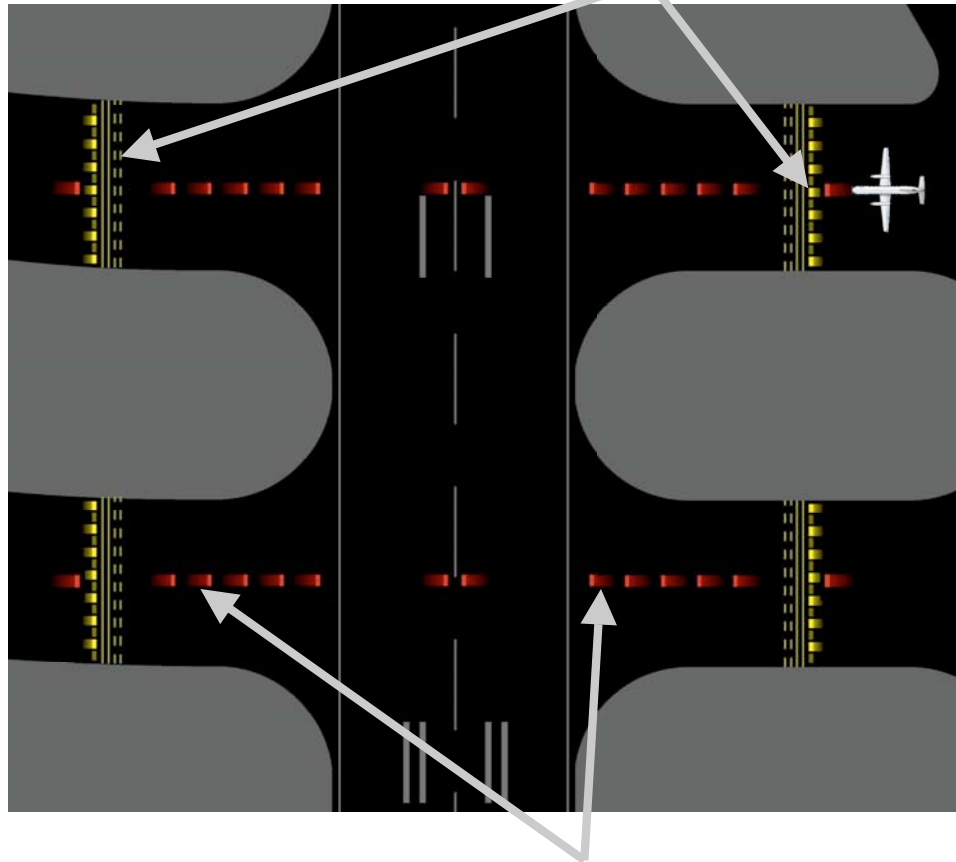


RWSL consists of Surveillance Sensors*, Safety Logic and fully automated RELs

***SAN will not have multilateration**

REL Operational Requirements

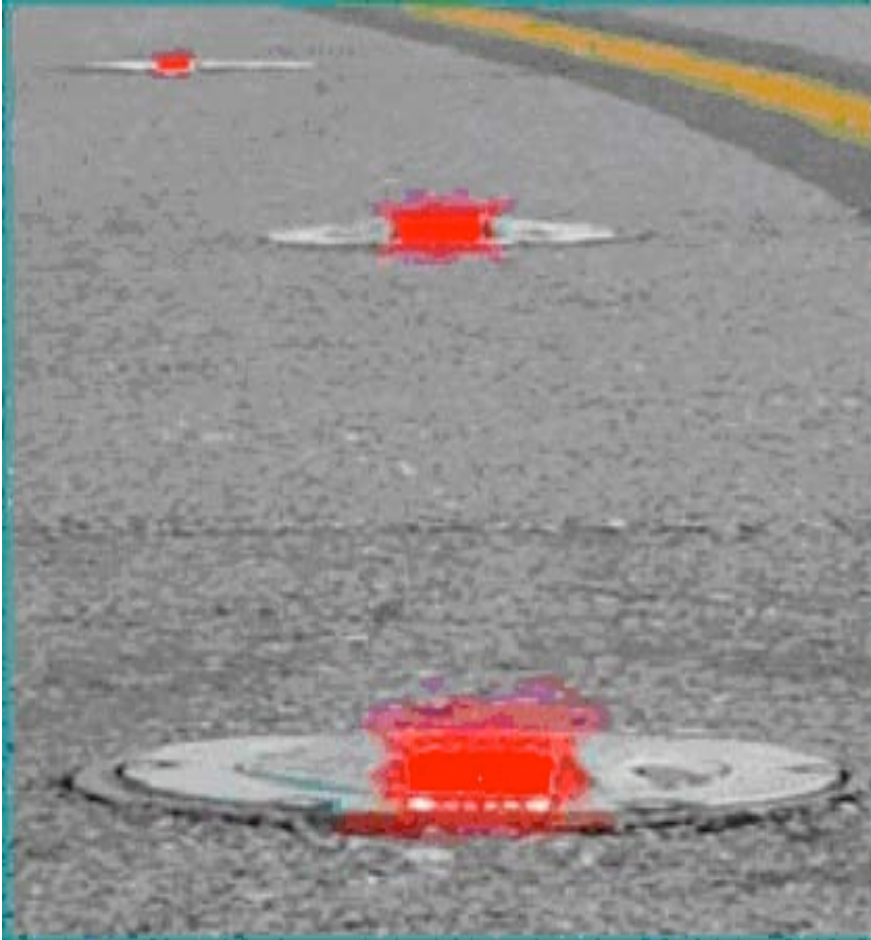
Runway Guard Lights (**yellow**)



Runway Entrance Lights (**red**)

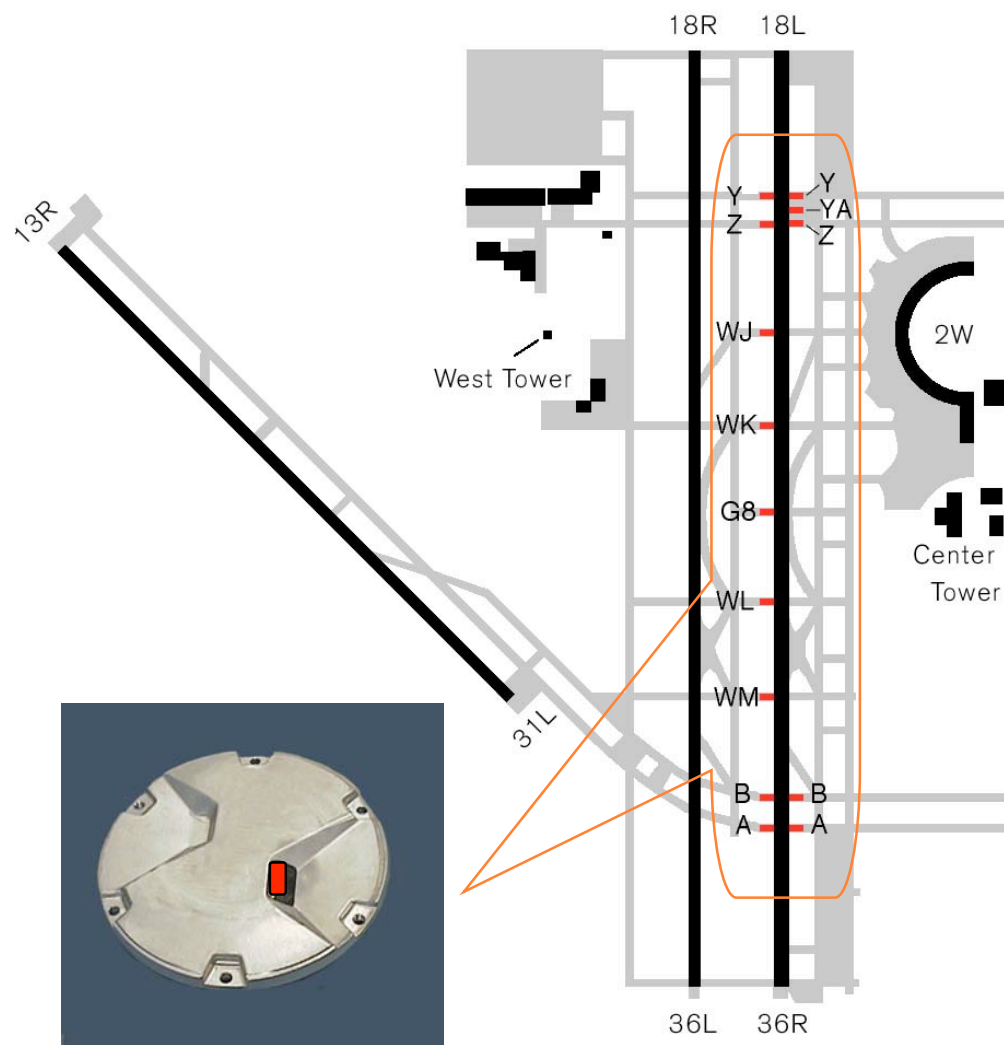
- RELs must accurately depict runway is unsafe to enter/cross
 - Red if runway not safe
 - Otherwise off (no illumination)
- RELs must not interfere with normal, safe operations
- RELs must operate automatically for each landing and departure

Placement, Direction and Intensity of RELs



- RELs aligned with taxiway centerlines
 - DFW: centerlines straight
 - SAN: centerlines curved
 - One REL is on runway centerline
- Light from all RELs is directed toward taxiway hold line
- Five standard intensity steps available
 - Daytime: RELs set at step 5
 - Nighttime: set to step 3 or one step higher than existing lights

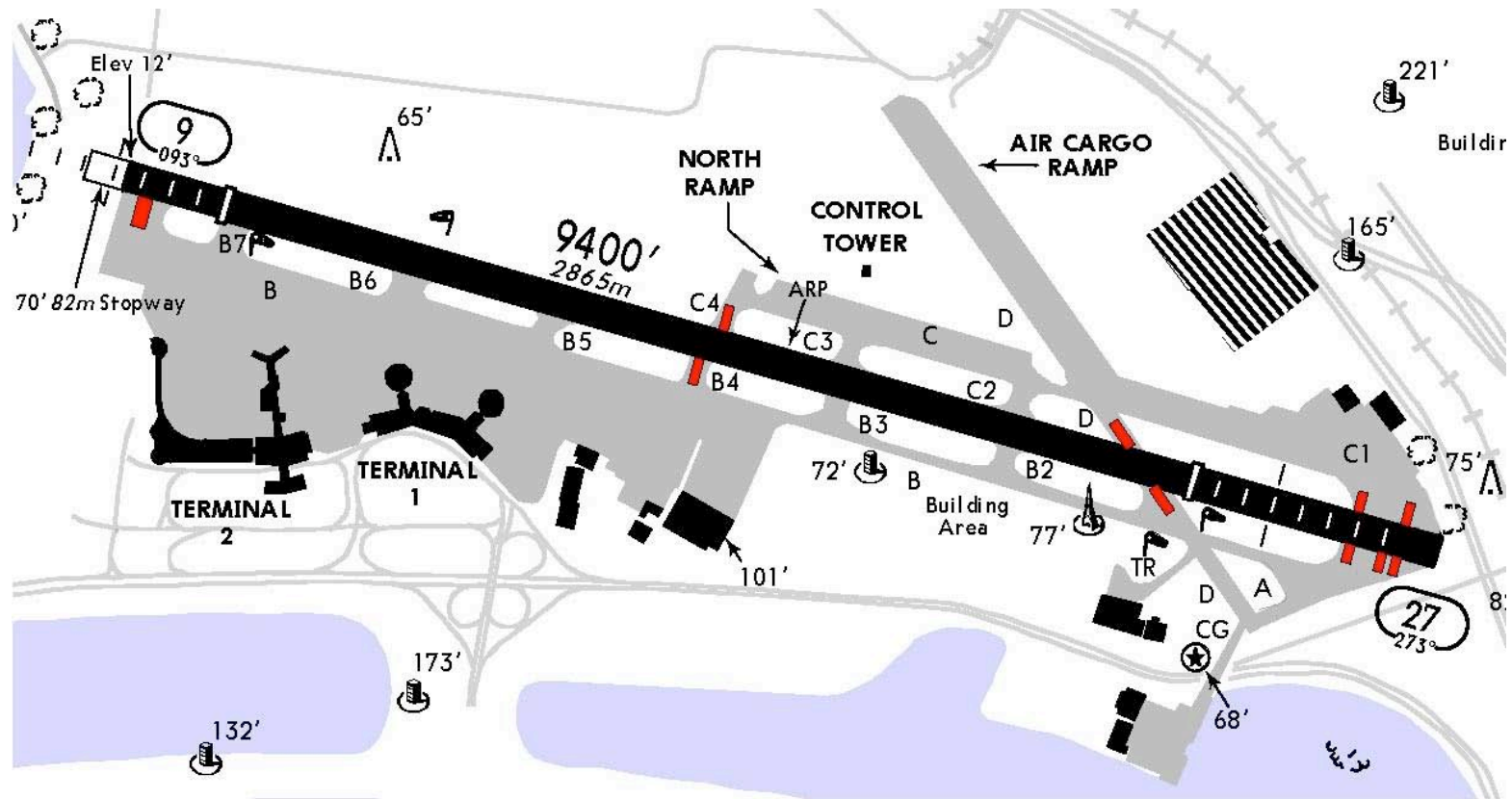
Operational Evaluation at DFW



REL fixture

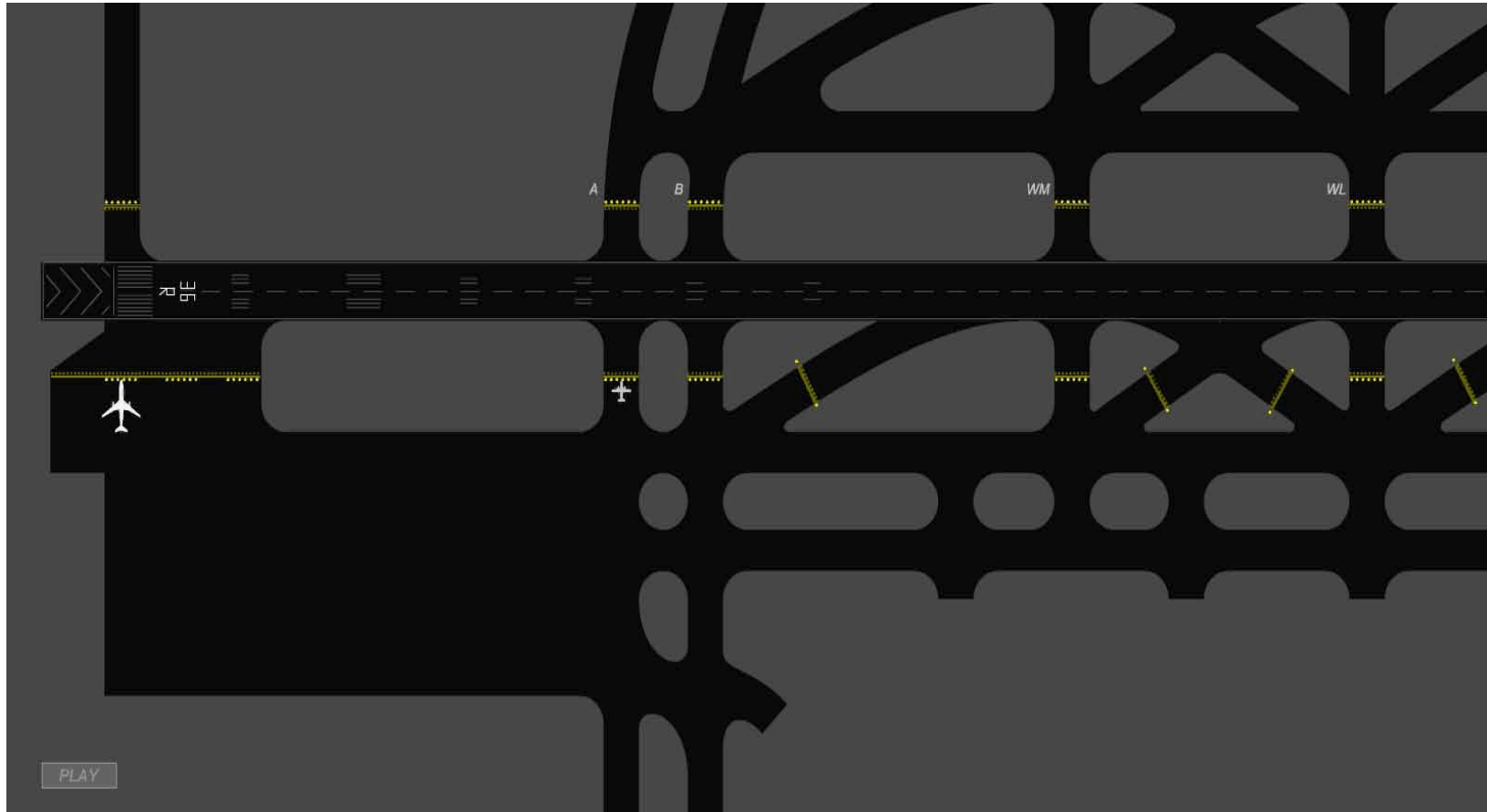
- RELs have been installed and tested on west side of DFW
- RELs on runway 18L/36R
- RELs only at selected intersections
- Inboard side:
 - TWYs Y, YA, Z, B and A
- Outboard side:
 - TWYs Y, Z, WJ, WK, G8, WL, WM, B and A

Operational Evaluation at SAN



- RELs have been installed and tested on RWY 09/27
 - North side: TWYs C1, D, C4
 - South side: TWYs B1, D, B4, B8

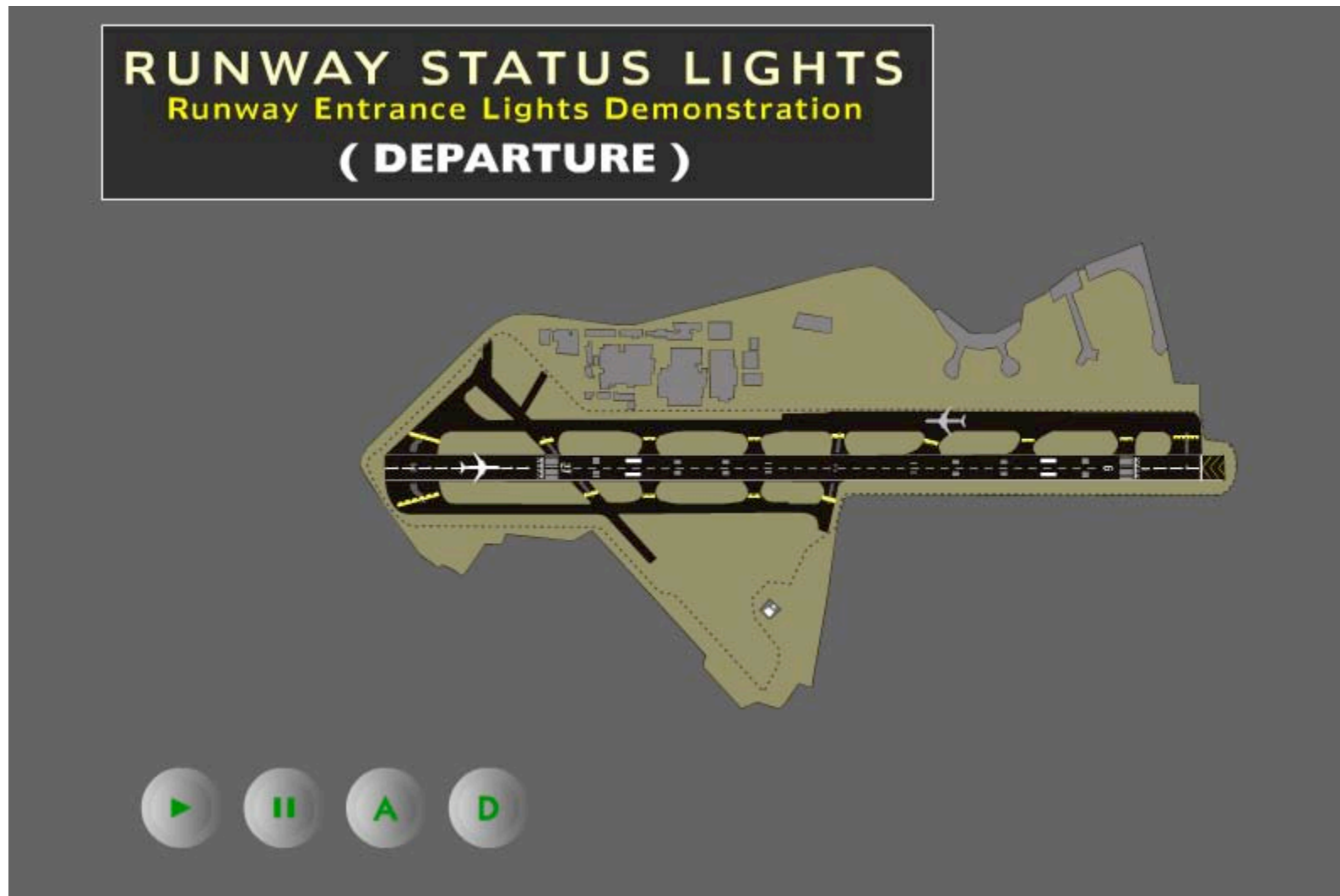
DFW REL Conops Animation



Script for DFW REL Conops Animation

1. Landing aircraft to 36R turns all RELs red when it crosses about 3/4 nautical mile final.
2. RELs progressively turn off (no illumination) as landing aircraft approaches each lighted intersection (about 3 seconds before aircraft passes the intersection to allow for anticipated separation clearances by ATC).
3. Small aircraft is cleared to cross, then crosses 36R at Alpha and REL is off so it does not interfere with normal, safe operations.
4. Departure is cleared for takeoff on 36R and REL is off so it does not interfere with normal, safe operations.
5. All RELs down field turn red simultaneously once the departure accelerates to about 20 knots.
6. Small aircraft at WM crosses the hold line and continues while RELs are red in front of it. The pilot crosses over four red RELs but stops short of the fifth and final red REL on the taxiway centerline, not crossing over the runway edge. At the same time, the departure has reached Alpha.
7. The departure continues its takeoff roll down the runway.
8. Aircraft stopped at WM then crosses with ATC clearance after the red RELs have turned off and after the departure has passed by that intersection.
9. Meanwhile, another small aircraft taxis to the hold line at Alpha and stops short of it, awaiting ATC clearance.

SAN RWSL REL Conops Animation



Script for SAN RWSL Conops Animation

- SAN Movie is an animated simulation of a typical arrival and departure event
 - Press “A” to view an arrival
 - Press “D” to view a departure
- For arrivals:
 - All RELs are simultaneously illuminated based on distance. The distance is one nautical mile from end of the runway.
 - When the aircraft decelerates through approximately 75 knots, RELs downfield are turned off except for the intersection the aircraft is approaching.
 - All the RELs are turned off when the aircraft slows to taxi speed.
- For departures:
 - All RELs in front of the aircraft are illuminated when an aircraft transitions from a taxi to a departure.
 - All RELs are turned off when the aircraft transitions from a departure to an airborne status (wheels off the ground and positive rate of climb).
 - For departure aborts, when the aircraft decelerates RELs will be turned off.
- For both arrivals and departures, RELs are turned off prior to an arrival or departure passing an intersection to allow for anticipated separation.
- Each individual intersection can be optimized.

Development Program

DFW Center Tower



Photo courtesy of NASA Ames

- Phase 1 (FY01-03)
Engineering Development
 - Passed FY03
- Phase 2 (FY02-04) Shadow Operations
 - Part 1 passed Sept 03
 - Part 2 passed June 04 at DFW, TBD at SAN
- Phase 3 (FY05) Operational Evaluations at DFW and SAN

REL Movies of DFW

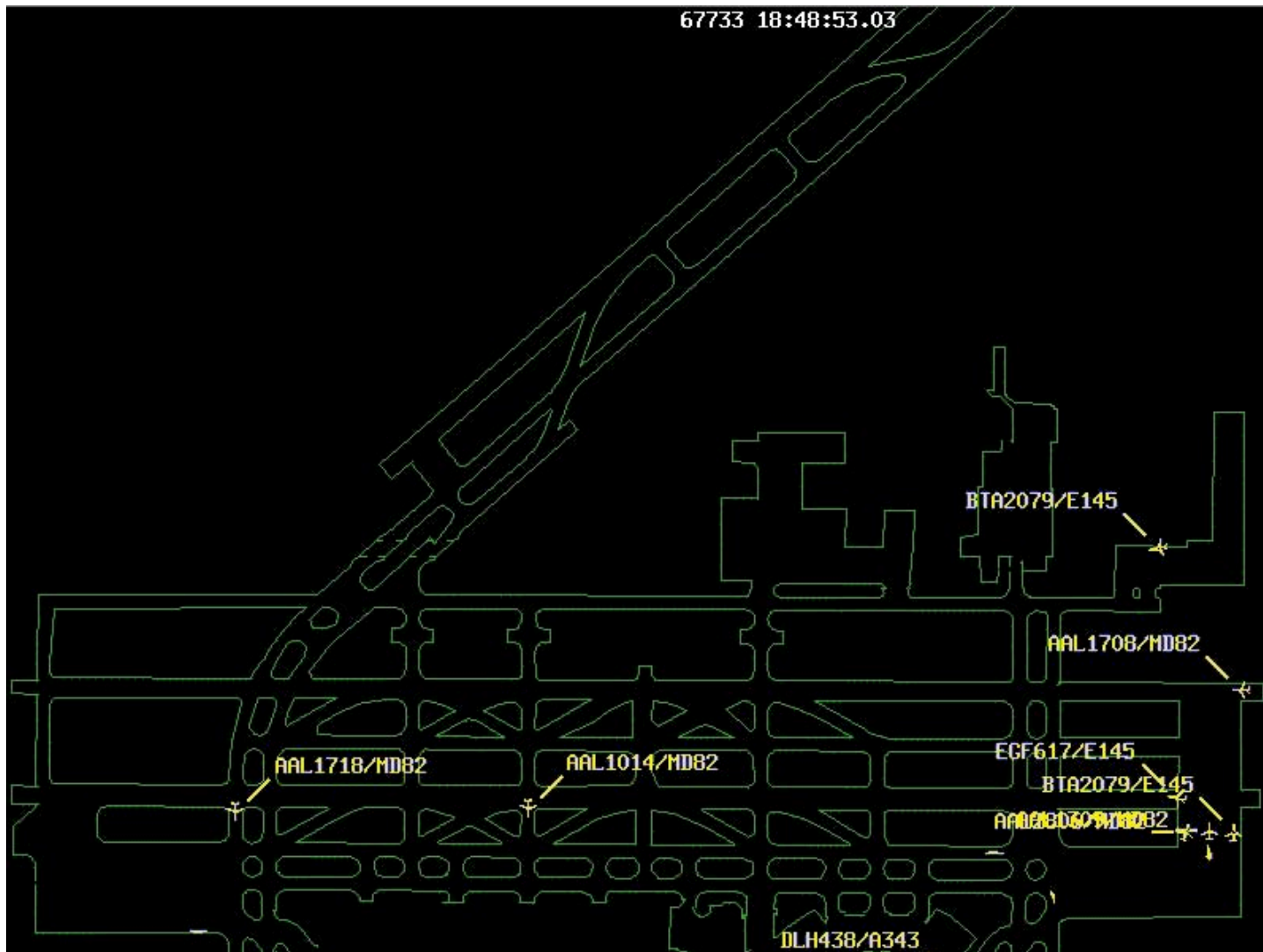
Arrival and Departure

- Actual traffic recorded at DFW RWSL Shadow Operations, June 2004, with RELs driven by safety logic shown in red on display but installed fixtures not turned on.
- Arrivals
 - All RELs are simultaneously illuminated based on distance, 3/4 NM from the runway threshold. When the aircraft decelerates through 80 knots, RELs downfield are off except for the intersection the aircraft is approaching. All RELs are off when the aircraft slows to taxi speed (about 34 knots). Here, EGF752 was cleared to land on 18L. At 3/4 nm all RELs turn on. Upon landing, RELs turn off at far end of runway and then at taxiway intersections the lander approaches as it decelerates to a landing roll out and finally a taxi speed.
- Departures
 - All RELs in front of aircraft are illuminated when aircraft transitions from a taxi to a departure at 20 knots. All RELs are off when the aircraft transitions from a departure to an airborne status (wheels off ground and positive rate of climb). Here, EGF617 is cleared for takeoff on 18L and all RELs turn on once it reaches 20 knots on the departure roll. All RELs turn off when it is airborne. For departure aborts, when the aircraft decelerates below 34 knots all RELs will be turned off.

Example RELs for DFW Arrival



Example RELs for DFW Departure



Pilot Information Sources

- RWSL information website
 - *www.RWSL.net*
- Magazine articles
- Poster placed in pilot briefing rooms
- CD-ROMs of PowerPoint presentations
- Notices to Airmen (NOTAMs)
- Automatic Terminal Information Service (ATIS)
- Jeppesen bulletin

RWSL ATC Test ATIS Message

- When DFW RWSL operations are active, the following message shall be recorded on the ATIS:
 - “Runway Status Light test in progress on runway 18L. **Stop at red lights.** Keep transponders on while taxiing.”
- When SAN RWSL operations are active, the following message shall be recorded on the ATIS:
 - “Runway Status Light operational evaluation in progress. Do not cross illuminated red lights at taxiway intersections.”
- When DFW or SAN RWSL operations are not active, this message shall be taken off the ATIS.

Pilot Test Procedures

- When RELs illuminate, the flight crew should remain clear of the runway.
- When cleared to takeoff, cross the runway, position and hold, or for immediate takeoff and RELs are illuminated, stop the aircraft and indicate to Air Traffic “Trans Air 123 stopped with red lights” and then wait for further clearance.
- If the aircraft crosses the hold line and the flight crew observes illuminated lights, then the flight crew should stop the airplane and notify ATC that “Trans Air 123 is stopped across the hold line because of red lights.”
- No new ATC procedures for RWSL
 - Controllers should use best judgment and applicable paragraphs from 7110.65 and 7210.3

Key Points of Pilot / Vehicle Operator Training

- RELs indicate runway **status** only; they do not indicate clearance.
- Clearance will be provided verbally by ATC as under current procedures.
- When lights illuminate, the runway is unsafe to enter and the pilots must stop immediately. Vehicle operators must also stop immediately unless directed otherwise by ATC to disregard the lights and cross.
- When the lights are off, pilots/vehicle operators may not enter or cross the runway without ATC clearance.
 - In some instances (anticipated separation), RELs may be illuminated while the clearance is being given, but should be turned off by the time the controller has finished issuing the clearance.

Handling RWSL System Anomalies

- If anomalies are impeding the flow of traffic, ATC will:
 - Turn off the RELs using the manual shutoff switch
 - Rebroadcast ATIS message with RWSL activity omitted
- The system is returned to service by the RWSL test team after concurrence from ATC
- Unless the system is creating anomalies, it will remain on throughout the Operational Evaluation
 - Operational Evaluation hours are typically 7am – 10pm

Example of System Anomaly Requiring REL Shutoff

- Controller issues clearance to enter or cross the runway.
- Pilot/vehicle operator responds that RELs are on.
- Controller responds with hold short instructions.
- Controller re-assesses the situation and determines the runway is safe to enter or cross.
- Controller asks the pilot/vehicle operator if the lights are still on.
- If lights are reported as still on, then RWSL is malfunctioning - turn RWSL off.
- Once lights are off, controller re-issues clearance or alternate instructions.

Operational Evaluation Completion

- Pending successful final results of RWSL operational evaluations at DFW and SAN, changes to require RWSL use will be published in:
 - AIM, Aeronautical Information Manual
 - ATC Handbook 7110.65
 - FAA Supervisor's Handbook

Summary

- RWSL Goal
 - Reduce runway incursions via increased situational awareness
- RWSL Method
 - Provide direct indication that a runway is **unsafe** to enter or cross
- RWSL Requirements
 - Controller acceptance: no impact on normal safe operations
 - Pilot acceptance: operational suitability of lights
- RWSL Information
 - www.RWSL.net

THANK YOU FOR YOUR PARTICIPATION IN IMPROVING RUNWAY SAFETY!

Feedback

DFW Shadow Ops I Pilot Feedback

- Ten pilots received training, observed RWSL during evaluation sessions
- Pilots wrote:
 - “I think RELs will greatly increase air safety through more situational awareness.”
 - “This appears to be an excellent system and should provide an increase in safety that makes it well worth the effort and expense.”
 - But also expressed concerns about:
 - Proliferation of lights on airport surface
 - Adequacy of training for crews

DFW Shadow Ops II Pilot Feedback

- Pilots evaluated RWSL positively
 - 9 surveys, 9 questions each survey plus comments
 - 9 of 9 responses were better than neutral
 - Good agreement among pilots' opinions
- Pilots wrote:
 - “If the system is working correctly, it should be transparent and it does appear to work well.”
 - “A real help in knowing that a runway is actually in use.”
 - “A picture is worth a thousand ‘do not cross.’”
- But also expressed concerns about:
 - Training for crews
 - Cost effectiveness of system

DFW Shadow Ops I ATC Feedback

- Tower Supervisors evaluated RWSL positively
 - 20 surveys, 11 questions each survey plus comments
 - 10 of 11 responses were better than neutral
 - Good agreement among supervisor teams' opinions
- Supervisors wrote:
 - “I feel the RWSL system will be an asset to ATC!”
 - “The system seems to provide an additional level of safety and be transparent to the controller.”
 - “Program has potential to provide multiple benefits to the ATC community.”
- Guidance (“must fix”) also provided
 - Suggested fixes were incorporated in updated logic for Shadow Ops II

DFW Shadow Ops II ATC Feedback

- Tower Supervisors evaluated RWSL positively
 - 7 surveys, 9 questions each survey plus comments
 - 7 of 9 responses were better than neutral
 - 2 neutral responses indicate communication load expected to be unchanged
 - Good agreement among supervisors' opinions
- Supervisors wrote:
 - “I do believe that this tool will help promote runway safety!”
 - “My observation is that this equipment is providing ‘real time’ data to pilots that will help aid the ATC system from runway incursions. Looking forward to implementation.”
 - “Over all, I like what I have seen up to this point and am excited at the possibility that there may be a system to aid in the reduction of runway incursions.”
 - “It is hard to believe that something of this nature has not been implemented prior to this date.”

Contact Information

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